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### **Costa Rica: Growing Trouble in Paradise**

What does the mere mentioning of the name Costa Rica evoke in one's mind? Rich coasts with endless lush, plentiful terrain in a Central American paradise nestled into a small niche known widely as a Latin American oasis? Are the loud, vibrant and colorful rainforests brought to the forefront of your mind? With such plentiful and luxurious accommodations—crystal clear waters, an explosion of biological diversity oozing from every crevice of the lush brush and canopy, who could imagine that a country this beautiful could suffer from any of the ills commonly known to developing countries today? Costa Rica is the most visited in country in Central America. With tourism accounting for nearly \$2 billion dollars and the motto of the tico people being “Pura Vida” [Pure Life], the simplicity of life comes to the forefront. Despite being an escape from the bustling cities we know today to an environment complete with friendly natives and glorious natural resources, Costa Rica continues to face challenges to its development with work to needing to be done in its communities in improved food security and increasing agricultural productivity. Next time at the grocery store, read where your fruit produce comes from. The United States imports agricultural produce largely from Costa Rica and neighboring countries. In our global economy, if anyone is starving and hungry, that is a threat to all of us around the world. The Costa Rican economy was primarily known principally as a producer of bananas and coffee. Even though coffee, bananas, pineapple, sugar, lumber, wood products and beef are still important exports, in recent times electronics, pharmaceuticals, financial outsourcing, software development, and ecotourism have become the prime industries (Barquero). According to the U.S. State Department, high levels of education among its residents make the country an attractive investing location. The country has successfully attracted important investments by such companies as Intel Corporation, which employs nearly 3,500 people at its custom built \$300 million microprocessor plant; Procter & Gamble, which is establishing its administrative center for the Western Hemisphere in Costa Rica; and Abbott Laboratories and Baxter Healthcare from the health care products industry (Costa Rica). Manufacturing and industry's contribution to GDP overtook agriculture over the course of the 1990s, led by foreign investment in Costa Rica's free trade zones. Well over half of that investment has come from the U.S. In 2006 Intel's microprocessor facility alone was responsible for 20% of Costa Rican exports and 4.9% of the country's GDP (Rottenberg 37-39).

The key factor in increasing agricultural productivity and improved food security is the conducting of scientific research into crop biology and agronomic technologies for improving yields, disease, and drought resistance and sustainable agricultural systems. The Costa Rican economy largely relies on tourism, agriculture, and the exportation of technological and electronic goods. Poverty has remained around 20%, and the strong social safety net that had been put into place by the government has eroded because of the increased financial constraints on government expenditures (Agriculture and Environment). Costa Rica has a large social welfare system and suffers from very high rates of inflation. Also, immigration from Nicaragua has increasingly become a concern for the government. The estimated 300,000-500,000 Nicaraguans estimated to be in Costa Rica legally and illegally are an important source of mostly unskilled labor, but also place heavy demands on the social welfare system (Costa Rica). This drain has caused strains on the Costa Rican government and its financial resources in investing in other fields.

Large international companies such as HIPP along with commercial conventional companies such as Chiquita Brands and Gerber baby food, have come in and have driven up food prices with their presence to the point where the locals that have had longstanding forests now have clear cut their forests to plant abandoned banana plantations, where nothing is done to replenish what is being taken from the

soil and the land is left barren (Costa Rican Agriculture). Literally hundreds of small growers are farming with slash and burn technologies to plant cacao for chocolate and bananas for baby food to sell their crop for profit (Costa Rica Agriculture).

Costa Rica's infrastructure has suffered from a lack of maintenance and new investment. The country has an extensive road system over 30,000 kilometers, although much of it is in disrepair. Most parts of the country are accessible by road. Costa Rica's ports are struggling to keep pace with growing trade (Where We Work). They have insufficient capacity, and their equipment is in poor condition. The government hopes to bring foreign investment, technology, and management into the telecommunications and electrical power sectors, which are monopolies of the state (Atlés 9-10). However, political opposition to opening these sectors to private participation has stalled the government's efforts. Costa Rica has a reputation as one of the most stable, prosperous, and among the least corrupt in Latin America. The poor state of public finances and the maladministration by state monopolies will continue to limit the state's ability to try to modernize these sectors in the absence of a political consensus to permit private investment (Atlés 23-24). Foreign investment is also a medium of improving agricultural conditions for the urban and rural poor in the country where the government is struggling to survive. The country needs the revenue and funds they bring in.

The upper layers of the soil, from which plants absorb almost all of the water and minerals they require to sustain themselves, contain an immense range of organisms interacting with one another and with the physical environment. According to Campbell, this encompasses an intricate, complex ecosystem that takes many centuries to form but can be destroyed by human mismanagement in just a few years. The texture and composition of the soil must be remembered when thinking about its ability to grow and support plant organisms for crop growth (871-872). Costa Rica has rich topsoil, thanks to the frequent rainfalls totaling about 4 meters per year and its nutrient-rich tropical environment (Rich Coast). The surface charges of soil particles determine their ability to bind many nutrients. Most soil particles are negatively charged. Positively charged cations—like potassium ( $K^+$ ), calcium ( $Ca^{2+}$ ), and magnesium ( $Mg^{2+}$ ) adhere to the soil particles. They are not easily lost easily lost by leaching, the percolation of water through the soil and roots. Roots do not absorb mineral cations directly from soil particles. But, they do so through cation exchange through the available soil solution. Mineral cations are displaced from soil particles by other cations like hydrogen ( $H^+$ ) and enter the soil solution only to be absorbed by root hairs. In short, soil management by means of fertilization and land conservation, help attain sustainable agriculture. Since Intel, the computer processing giant, holds a big chunk of the Costa Rican economy, the construction of the large plant is important but has been one reason natural habitat is being lost in the country. They produce chips for computers all around the world. Since these types of plants can easily leave toxic heavy metals or organic pollutants, there is one solution. As Reece states, phytoremediation is a method that is a technique of nondestructive biotechnology that harnesses the plant's ability to extract soil pollutants and concentrate them in portions of the plant that can easily be removed for safe disposal. This technology can also include protists and prokaryotes to detoxify polluted sites. Macronutrients and micro nutrients are required in plants in either small or large amount for the survival of the crop or food source (Reece 1021-1030).

Biotechnology allows modern plant breeders to use techniques for genetic engineering and can transfer genes between closely related species or plant varieties or variants of the same species (Campbell 807). Over time, a plant could be developed that can withstand something like insect infestations, something Costa Rica has plenty of. Using transgenic crops, crops with genes brought into the plant population, technology has allowed us to protect certain populations. The transgenic plant, for example, could code for a certain protein like a Bt toxic that is lethal to insect pests. "By using plant varieties like this, we can reduced and hopefully eliminate the use of chemical pesticides that have shown through numerous studies that they can be harmful to both the wildlife and human population" (Campbell 1027).

Only alkaline conditions like the guts of insects would activate the toxins. Organisms with acidic stomachs like humans and farm animals would destroy the protoxin without it becoming active (Campbell 1028-1035).

The only problem with this is that those same introduced genes can escape to the weed and other plant population since plants can sexually reproduce through natural selection. Developing sterility in male plants could prevent males from spreading pollen, thus reducing the risk for the problem of gene escape to arise (Campbell 1029). Biotechnologies are techniques that use living organisms to make or modify a product. Some biotechnologies are common and accepted, like fermentation for bread or alcohol production. Also conventional biotechnologies like breeding techniques and tissue cultures are accepted. The goal is to create varieties with better characteristics or increased yields. But, genetic modification by inserting genes from other organisms is contentious. Some GM crops can bring yield gains in some places and declines in others. Because new technologies are being rapidly developed, more long term assessments of results tend to lag behind our discoveries. The possibility of patenting genetic modifications can attract investment in agricultural research (Hartl 200-203). However, this could lead to a monopolistic concentration of ownership resources, causing costs to be driven up, inhibiting independent research, and undermining local farming practices like seed-saving that are essential in developing countries. The government continues to grapple with its large internal and external deficits and sizable internal debt for funding of this type of extensive research. Reducing inflation remains a difficult problem because of rising import prices, labor market rigidities, and fiscal deficits.

In Costa Rica, with a population around 4.2 million people, the typical family size consists of a four to five member household, the average woman is expected to have 2.1 children, the standard and quality of living is very high for a Latin American country, 96.5% of people are literate, the people are widely educated and the life expectancy for the total population is 77.4 years old, 74.79 years for males and 80.14 years for females (Costa Rica-CIA). The average child spends twelve years in school before possible colligate matriculation. The majority of people are employed in the tourist industry, ecotourism industry, the agricultural industry, and the manufacturing industry. The average income for a family is \$13,950 dollars. The Costa Rican currency is the colón (Costa Rica Wikipedia). In Costa Rica, more than 60% of the population lives in cities (Rottenberg 42). And, in Costa Rica a family of four needs an income of ₡447.788 (\$904) monthly to meet living expenses, including the cost of food, water, electricity, telephone (home phone and cellular), bus fares, a couple of nights out to a restaurant and payment of a mortgage of ₡20 million colones (\$40,500). “That figure is much higher than the ₡107.220 (\$216) colones the Instituto Nacional de Estadística y Censo (INEC) says is needed to make up the basic food basket and more than twice the average income of ₡259.722 colones (\$524)” (The Future World of Agriculture). According to the INEC, general incomes range from ₡223.350 (\$451) monthly paid by private business to ₡371.027 (\$749) paid by the central government and ₡461.500 (\$931) paid by the government institutions and agencies. Families outside of San José, like Alajuela require use a vehicle, and the monthly cost increases to ₡575.848 (\$1162), not taking into account the recent round of increases in fuel, as well as the recent increases in food items such as milk, rice and beans (Quality of Life in Urban Neighborhoods in Costa Rica).

The large products made in Costa Rica are bananas, pineapples, coffee, melons, ornamental plants, sugar, corn, rice, beans, potatoes, beef, and timber (Costa Rica Agriculture). Over 16% of the people live below the poverty threshold. About 4.5% of people are unemployed. The industries that are most important are microprocessors, food processing, medical equipment, textiles and clothing, construction materials, fertilizer, and plastic products (Costa Rica-Economy). Tourism now earns more foreign exchange than bananas and coffee combined. The major barriers to improving income in Costa Rica are the influx of a large number of Nicaraguan workers and workers from neighboring countries that come seasonally for employment only to return back home after their seasonal work is over. This work is

in the same three industries the Costa Rican economy relies upon. The major barriers to improving access to nutritional foods is the lack of money for the family living at or near the poverty line, the dwindling space for agriculture, and the high prices caused by the entrance of international companies to use the land due to the low taxes the Costa Rican government provides to encourage investment. Despite Costa Rica's efforts to protect its valuable forest resources, much of what lies outside the country's protected reserves is subject to deforestation (Plan Estratégico Institucional 2008-2010). Land is cleared for cattle ranching and for harvesting valuable tropical timber for export. In addition, because some of Costa Rica's protected lands are privately owned, their protection from future deforestation is not guaranteed (Yale University Environment Index).

For Costa Rica, the key factor in increasing agricultural productivity and improved food security is the conducting of scientific research into crop biology and agronomic technologies for improving yields, disease, and drought resistance and sustainable agricultural systems presently plays into families not being able to earn enough income to purchase food because the government can not invest enough because of its large and demanding other fiscal responsibilities. The social welfare system largely drains the funds of the country, and migrant workers from around the region still benefit from its perks since they work in the country. Also, funding for crop biology is lacking because the infrastructure of the country is crumbling because of a lack of financing from the government.

The role of scientific research for crop biology and agronomical technology plays into food availability and cost for an urban family because the agricultural centers and resources in the country are not producing enough food efficiently to make food affordable to all. Prices are rising while wages are stagnant. Currently, the present status for this factor is the fact that research is being done on the university, governmental, and scientific level. However, there is insufficient funding to produce results that would benefit on a large scale and in local populations. The situation is not as severe as in other countries by far. The poverty rate is becoming lower every year. However, it still needs to be addressed in this country. About 64% of the necessary amount of food and income is being attained (Trejos 2). Prices have strained some families' ability to keep up with their needs and their families' needs.

The environment is being degraded through deforestation and the non replenishment of spent soils and agricultural areas. And, women, urban poor, rural poor, and developing nations are disadvantaged. Women are among the poorest and are employed in these fields. According to Medeiros, poor women in Costa Rica are single mothers who have the sole responsibility for child care, which may make it difficult to work standard hours and earn enough. The rural poor lack the access and proximity that people close to cities and economic centers have (Zúniga 9). And, the urban poor face increased competition for a few resources that all cannot have. Urban poor compete for the same jobs, access to resources, and opportunities (Slon 3). And, developing nations do not always have the resources or ability to initiate investment into crop biology and agronomic technology in improving yields, disease, sustainability, and drought resistance because of their other more pressing issues or the government's absent role.

The trends so far are looking good for crop biology and agronomic technologies. More places are slowly but surely gaining access to more beneficial crop biological and agronomical technologies. Companies and outside governments have invested more and more into research. The trends for this factor are measured in the amount and effectiveness of new developments and technology that can go to benefit agriculture on a wide scale and with individual areas and regions where needs are different. These measurements do indicate that the situation is changing for the good. Tourism brings in a lot of money, and that is beginning to improve situations for everyday people. The quality of life is already high. The life expectancy is high; the infant mortality rate has steadily lowered, and generally people in Costa Rica live lives among the highest quality around the world. Because of the potential change, the situation for a

farm family in Costa Rica is getting better, but slowly. Widespread education along with an aggressive campaign by the government is the way that the situation could be changed faster compared to limited change in rural, remote areas.

Improving this factor would increase the amount of food and income available to my family because if the supply and accessibility to food is solid because of scientific crop biology and agronomical research, the speed of food growth and agricultural production and efficiency will increase. More people will have access to food and they will not go hungry. Income would rise because if the supply of food is greater and more readily accessible, prices will lower since there are more goods available and people are competing for a larger amount of resources. More people will be put to work because of the new technological developments. Technology requires the operation of machinery and the use of equipment, and Costa Rica is the major producer of computer chips and other technological resources. Farmers and growers make more money and stand to make a profit if yields are increased. If diseases are eradicated and do not affect as many crops, there will be a greater amount of crops available. Drought resistance in crops can help because in certain parts of the country, there are seasonal rainfalls that affect some regions but do not affect others. Coastal trade winds also help aid the several different microclimates in the country by bringing in moisture. Environmental preservation would be achieved through technological advances in crop biology and agronomy because the knowledge for responsible behavior and methods of farming would be widely used and practiced because producers would understand the benefits of protecting resources and ease human impact. Improving food resources and crop issues to improve production and efficiency will help women access food for themselves and for their families if applicable. For example, current Costa Rican legislation limits the ability of employers to employ women at night (Poverty and Inequality from a Gender Perspective). Before, working nights might have been necessary to generate enough income to buy limited food available. Urban dwellers will have increased food supplies to access, and Costa Rica has a small market for food compared to other nations. Small famers will increase food for themselves while making more money and profit, and developing countries would have less starving people because of increased access.

Increased productivity and yields by small-scale subsistence family farmers can affect the status and trends of this factor because more production and supply would help the family farmers feed themselves adequately and have enough to sell to others around and increase available supply to help ease the problem of food insecurity. If more crops and foods are produced, this would improve the livelihoods of my urban family because food supplies would be greater, and greater supplies help to ease large demand and help to bring down prices and increase everyday accessibility for the urban family.

Based on my research, my recommendations as to how increased productivity by small-scale subsistence family farmers should be implemented to increase food security and incomes of urban families in Costa Rica are by means of investing significant monetary and technological resources through government funding into research to develop innovative and effective methods. This research needs to be a widespread and informative campaign to family subsistence farmers in order to inform them and allow them to deploy new, effective methods that have been extensively researched and tested to increase crop yields and increase yields and drought resistance while maintaining food safety. Also, the aid of other nations should be sought, especially those who have interests in the country. The government has to find a way to improve its financial outlook so that it can provide funding to those family subsistence farmers. This, in effect will help the urban poor. More food will be accessible, there will be a larger supply, and the increased supply will reach more people and hopefully drive down prices closer to a level of affordability that can be reasonably sustained. As the technological sector in agriculture expands, it will hopefully open up more new jobs, and larger crop yields will require more work to prepare and handle. Lastly, the same amount of money could possibly buy more food than before.

My suggestions on the appropriate roles of corporations are to put money back into the development of new and better technologies in crop biology, engineering, and agriculture. Investment can very well benefit the company in that region or overall. If Chiquita, for example invested more into creating new ways to preserve the environment and produce more bananas, it could sell more, feed more people, help stimulate the national and local economy, and increase its profit. The national government has to improve its fiscal nightmare and get a handle on its finances in order to better serve its problems and needs. The United Nations and other non-profit and civic organizations can increase worldwide awareness and serve as a medium to bring needed funds, aid, and resources to Costa Rica to help ease the problem. And, these same organizations can share the methods they use to implement the improvement of conditions. After all, if people around the world are not food secure, then it affects our food security as well. Educating the poor farmers will go a long way in improving conditions overall and producing more food.

Costa Rica also has a water cleanliness issue. Much of Costa Rica's municipal sewage is discharged without treatment into rivers and streams. Also, wastewater collection systems are degraded, allowing fecal matter to seep into subterranean water sources (Costa Rica UN). Untreated sewage, agrochemical runoff, and wastewater from different sources pollute river systems. Consumption of water contaminated with raw sewage or runoff containing fecal pathogens may cause a variety of acute enteric infections. And, these same things are being used as water to grow crops (The Political Economy of Poverty, Equity and Growth). Ocean beaches are reportedly unsafe for recreational activities because of high levels of fecal contamination. Fuel spills, primarily in coastal areas, are common in Costa Rica. Small scale oil and fuel spills in rivers and marine systems normally pose only transient and low risks to human health, but may damage a variety of water treatment systems, including those using semi-permeable membranes (Barquero). Vegetables may be contaminated with raw sewage that commonly is used as fertilizer for gardens and farms. Consumption of food contaminated with fecal pathogens may cause a variety of acute enteric infections. Harmful algal blooms in coastal waters may contaminate seafood from coastal waters with toxins causing neurotoxic shellfish poisoning. Acute effects include tingling and numbness of the lips and tongue, muscle aches, nausea, and dizziness. Onset of symptoms can occur within a few hours and subside within a few days at most. Cooking does not destroy the toxin (United States State Department).

16% of the country consists of those poor agricultural workers. And, until the government steps up its role in providing funding to biological research where small farmers cannot afford to lose crops to pesticides and other crop ailments, nothing will drastically change. Only through conservation and research can the condition of the Costa Rican rainforests and vast agricultural land improve. Plant breeding has increased crop yields and has improved the nutritional value of several crops, including corn, soybeans, and wheat. It also has led to the development of new types of plants. It is understood that the role of agronomist includes seeing whether produce meets the following conditions of land and water access, commercialization [market], quality and quantity of inputs, risk protection [insurance], and agricultural credit (The Future World of Agriculture). The period when poverty rates stagnated in Costa Rica despite growing average real earnings and incomes coincided with a period of a large increase in the proportion of households headed by women, and an even larger increase in the proportion of poor households headed by single mothers (Family Structures, Household Work and Well-Being). Because households headed by single mothers are more likely to be poor than any other type of household, the increase in the proportion of households headed by single mothers, by itself, increased poverty rates (Bubinic, Gupta 51). In conclusion, the livelihoods of subsistence farmers can be improved by increasing the productivity of staple crops in lagging regions, a move that would require major investments in soil and water management and in agricultural research. It also calls for an improved investment climate for agribusiness. Improving yields on subsistence farms will depend on agricultural science; access to technology, land, and water; open and available markets; and economic incentives and supporting

institutions. Appropriate action must address these interrelating factors in ways that balance increasing production with the needs of family farmers and their communities.

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